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Application of Biosorption technology for remove heavy metal (Cadmium) in wastewater

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ABSTRACT

This study was performed to evaluation of biosorption technology application for remove heavy metal (Cadmium) in wastewater. At this study, *Saccharomyces cerevisiae* was applied for biosorption of Cadmium element from industrial wastewater. Effect of Two factors were studied on value of absorption included biomass concentration (2, 3, 4, 5 and 6 g/l) and contact time (15, 30, 60 and 120 min). pH value and temperature were fixed at 6 and 25˚C in experiment period, respectively. it was determined that Cadmium absorption rate decreased with increasing concentration of biomass adsorbent. Also, Absorption was increased with increasing of time and using of 30, 60 and 120 minutes increased absorption 1.28, 1.85 and 2.61 fold in compare to 15 minute.

Introduction

Biosorption is considered a potential instrument for the removal of metals from waste solutions and for precious metals recovery, an alternative to the conventional processes, such as those based on ion exchange, or adsorption on activated carbon (Veglio and Beolchini, 1997). Heavy metal pollution has become one of the most serious environmental problems today. Biosorption, using biomaterials such as bacteria, fungi, yeast and algae, is regarded as a cost-effective biotechnology for the treatment of high volume and low concentration complex wastewaters containing heavy metal(s) in the order of 1 to 100 mg/L. Among the promising biosorbents for heavy metal removal which have been researched during the past decades, Saccharomyces cerevisiae has received increasing attention due to the unique nature in spite of its mediocre capacity for metal uptake compared with other fungi. *S. cerevisiae* is widely used in food and beverage production, is easily cultivated using cheap media, is also a by-product in large quantity as a waste of the fermentation industry, and is easily manipulated at molecular level (Wang and Chen, 2006). Characteristics of *S. cerevisiae* in heavy metal biosorption are extensively discussed. The yeast can be studied in various forms for different purposes. Metal-binding capacity for various heavy metals by *S. cerevisiae* under different conditions is compared. Lead and uranium, for instances, could be removed from dilute solutions more effectively in comparison with other metals. The yeast biosorption largely depends on parameters such as pH, the ratio of the initial metal ion and initial biomass concentration, culture conditions, presence of various ligands and competitive metal ions in solution and to a limited extent on temperature (Lin *et al.*, 2005; Jianlog, 2002). In another study, The effect of initial metal concentration and pH on biosorption by ethanol treated yeast was studied by Göksungur et al., (2005), he maximum metal uptake values (q_{max}, mg g^{-1}) were found as 31.75 and 60.24 for Cd^{2+} and Pb^{2+}, respectively. Competitive biosorption experiments were performed with Cd^{2+} and Pb^{2+} together with Cu^{2+} and the competitive biosorption capacities of the yeast biomass for all metal ions were found to be lower than in non-competitive conditions. The effect of initial metal concentration and pH on biosorption by ethanol treated yeast was studied. So, the aim of this study was evaluation of biosorption technology application for remove heavy metal (Cadmium) in wastewater.

Material and Methods

At this study, *Saccharomyces cerevisiae* was applied for biosorption of Cadmium element from industrial wastewater. Effect of Two factors were studied on value of absorption included biomass concentration (2, 3, 4, 5 and 6 g/l) and contact time (15, 30, 60 and 120 min). pH value and temperature were fixed at 6 and 25˚C in experiment period, respectively. Absorption rate was calculated in terms of the balance using the following equation.

$$q_e = \frac{V\,(C_0 - C_e)}{m}$$

q: The amount of absorbed metal ions per unit mass of adsorbent (mg/g), V: The volume of waste (L), C_0: Ion concentration in wastewater (mg/l), C_e: The balanced concentration of metal ion in wastewater (mg/l).

Result and discussion

According to result it was founded that biomass concentration and time had significant effect on absorbed cadmium. Also it was determined that Cadmium absorption rate decreased with increasing concentration of biomass adsorbent. With increasing concentrations absorber, active sites increase for absorb of ions but since the active sites are not fully saturated, it decrease amount of absorption per unit mass of adsorbent (q) (Fig 1). Chang *et al*., (1997) reported that the increase in mercury concentration (from 0 to 50 mg Hg^{2+}/litre) in the growth media did not significantly affect the adsorption capacities of Pb^{2+}, Cu^{2+} and Cd^{2+}. However, the saturation uptake capacity and metal-cell affinity tended to increase as pH increased, until metals precipitated as metal hydroxides when the pH exceeded some threshold values and, The biomass resulted from desorption processes was able to retain approximately 80% of original adsorption capacity for Pb and Cu with four repeated adsorption and recovery runs.

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Regeneration of biomass appears to enhance the uptake capacity of Cd by nearly 35% after four adsorption/desorption cycles. Absorption was increased with increasing of time and using of 30, 60 and 120 minutes increased absorption 1.28, 1.85 and 2.61 fold in compare to 15 minute. The main reason for the increase in absorption over time can be at increased risk of collision the metal ions with the active sites of adsorbent (Fig 2). Singleton and Simmons (1996) reported that increasing the concentration of biomass in experimental flasks from 1 to 8 mg cm^{-3} decreased both silver accumulation, from $224^{\cdot 7}$ to $89^{\cdot 5}$ µmol Ag g^{-1} dry wt, and associated H^+ ion release, from $109^{\cdot 4}$ to $31^{\cdot 7}$ µmol H^+ g^{-1} dry wt. The presence of 1·0 mol dm^{-3} cadmium or methionine decreased silver biosorption by 40% and 93% respectively. Results of Naeem *et al*., (2006) suggest that *S. cerevisiae* may represent a novel biosorbent for the removal of heavy metal cations from aqueous waste streams. According of interaction between time and adsorbent concentration, it was founded at all concentrations, Absorption was increased with increasing of time but this enhancement was lower in concentration of 5 and 6 g/l treatments (Fig 3).

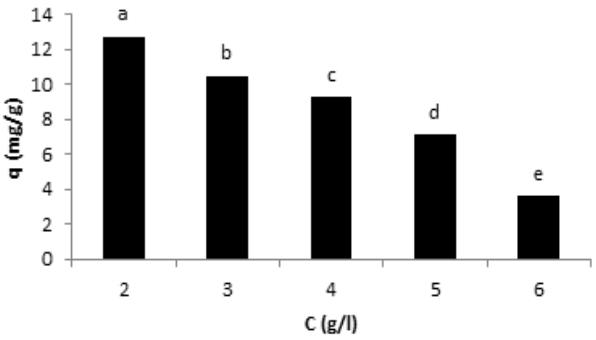

Fig 1. effect of adsorbent concentration on absorption value.

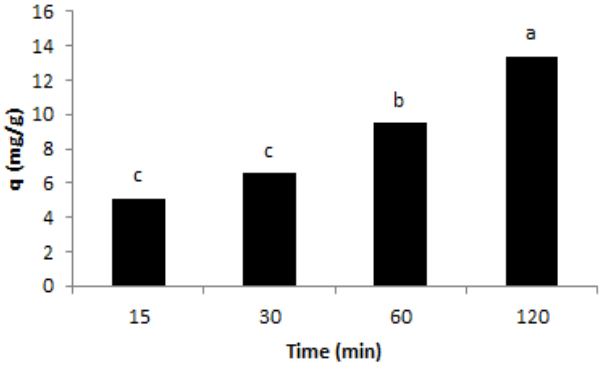

Fig 2. effect of time on absorption value.

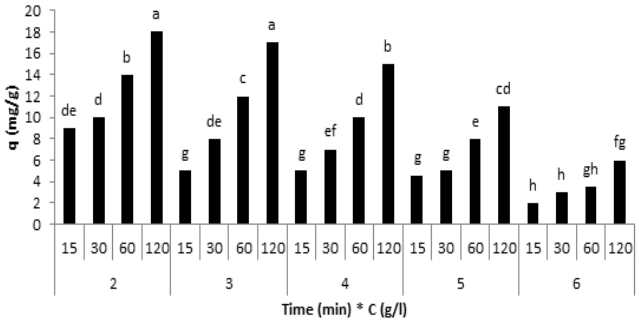

Fig 3. interaction of adsorbent concentration and time on absorption value.

Resources

1. Chang, J.S., Law, R. and Chang, C.C., 1997. Biosorption of lead, copper and cadmium by biomass of Pseudomonas aeruginosa PU21. *Water research*, *31*(7), pp.1651-1658.
2. Göksungur, Y., Üren, S. and Güvenç, U., 2005. Biosorption of cadmium and lead ions by ethanol treated waste baker's yeast biomass. Bioresource Technology, 96(1), pp.103-109.
3. Jianlong, W., 2002. Biosorption of copper (II) by chemically modified biomass of Saccharomyces cerevisiae. *Process Biochemistry*, *37*(8), pp.847-850.
4. Lin, Z., Wu, J., Xue, R. and Yang, Y., 2005. Spectroscopic characterization of Au 3+ biosorption by waste biomass of Saccharomyces cerevisiae. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, *61*(4), pp.761-765.
5. Naeem, A., Woertz, J.R. and Fein, J.B., 2006. Experimental measurement of proton, Cd, Pb, Sr, and Zn adsorption onto the fungal species Saccharomyces cerevisiae. *Environmental science & technology*, *40*(18), pp.5724-5729.
6. Singleton, I. and Simmons, P., 1996. Factors affecting silver biosorption by an industrial strain of Saccharomyces cerevisiae. *Journal of chemical technology and biotechnology*, *65*(1), pp.21-28.
7. Veglio, F. and Beolchini, F., 1997. Removal of metals by biosorption: a review. *Hydrometallurgy*, *44*(3), pp.301-316.
8. Wang, J. and Chen, C., 2006. Biosorption of heavy metals by Saccharomyces cerevisiae: a review. *Biotechnology advances*, *24*(5), pp.427-451.